reflects differences in terrain, is directly comparable across the nation and closely approximates the service areas that engineers consider when making decisions on facility provisioning.

B. Determination of Technology and Facility Mixes

Technology choices and facility mix determinations also have a significant impact on the investment required levels for providing customer access. The impact of these choices is reflected in the selection of the breakover point for use of electronic facility provisioning and in the placement costs which the company incurred (e.g. burying cable in some densely populated areas may be considerably more costly than placing aerial facilities. The ideal determinant is a methodology which reflects the actual choices faced by engineers in placing facilities. Included in this consideration would be a combination of density, soil type and community regulations.

C. Methodology Used in Assigning Locations to Wire Centers

The wire center assignment methodology has a twofold impact on the determination of loop investment. First, identification of a particular wire center to serve a household or clustered group of households has a direct bearing on the length of the loop required, the difficulty of placement in the terrain, and other cost related characteristics. Second, the identification of serving wire center determines the local exchange company that serves a geographic area. In the first case the cost of the loops represented in the model will differ from the serving company's attainable cost if end users are assigned to the wrong wire center. In the second case, inaccurate assignment can lead to shifts in subsidy requirements between companies; clearly an undesirable effect. Once again, the ideal methodology should reflects the real world decisions which would result from efficient engineering practices. It should take into account such things

California using actual customer locations – later versions used small uniform geographic groups of customers in order to avoid the need to use proprietary data).

as impassable terrain, communities of interest and population clusters in the same manner as these characteristics are considered by engineers and construction planners.

D. Assumptions Behind the Development of Financial Data

Financial inputs have a significant impact on universal service costs. These inputs include determination of economic lives of equipment, and the associated depreciation levels. They include selection of the cost of money, determination of reasonable contribution levels to shared and common costs, and selection of the appropriate levels of element costs and service revenues to be included in subsidy determinations. An ideal methodology in this area would reflect: 1) the costs of maintaining a readiness-to-serve level of assets associated with the carrier-of-last-resort obligation; 2) selection of market determined equipment lives to reflect a fully competitive environment; 3) recognition of changes in return (cost of money) requirements; and 4) development of sufficient margins in subsidization levels to attract equal or more efficient competitive network suppliers.

E. Ability to Modify Data to Reflect Unique Situations

As no one methodology is likely to be able to address every situation, another desirable characteristic of a proxy model is the ability to be easily modified to reflect situations that were either not accounted for in the original design or have arisen after the model has been developed. It is most desirable to allow controversial methods, data and assumptions to be changed by the user of the model, without intervention from programming staff or the original developers. While such an ideal is unlikely to occur, models constructed with more flexibility are more desirable than those with less.

II. Overview Of Models Reviewed In This Submission.

A. Benchmark Cost Model - Version 1 (BCM1)[2]

Version 1 of the Benchmark Cost Model was jointly sponsored by USWest, NYNEX, Sprint and MCI. The purpose of the model was threefold:

First, it was to be used to identify *average* costs required to serve residential customers residing within Census Block Groups.

Second , it was intended to develop a range of benchmark costs reflecting the provision of basic residential service by means of efficient design and the use of state-of-the-art technology. It does not develop actual or embedded costs, it does not claim to model the cost of the company which is obligated to provide service to the households in a given census block group (although it does use existing switch locations); it does not include business lines in its calculations either for purposes of determining business costs or for calculating the economics of scale in serving residences. An estimation of business lines was used only in calculation of the shared costs of switching.

It's third purpose was to allow evaluation of differing proposals for targeting high cost support, primarily through the use of different benchmark revenues above which subsidies would occur. The model would calculate a total subsidy for an area, based on the difference between the benchmark cost level and the rate to be charged or revenue per line anticipated to be received by the Universal Service Provider..

Some of the important methodological aspects of the BCM1 model are:

- <u>Geography</u> The use of Census Block Group (CBG) was used as the geographical base unit. Each CBG is identified by number and carries the total number of resident households (generally a CBG has between 250 and 550 households but the range of households is considered greater) as

[2] The overview of the Benchmark Cost Model - Version 1 was created from the slide presentation given by the Joint Sponsors on September 22,1995 in Denver. I am unaware of any official overview that has been produced for this model.

well as the number of square miles of area in the CBG . BCM1 then assumes this area to be a square in shape around the centroid of the CBG[3].

- Assignment of CBGs to Wire Centers. Wire Centers are assigned to CBG by determining the nearest wire center calculated using airline distance from the Wire Center to the centroid of the CBG. All households in the CBG are assigned to one wire center.
- Feeder Topology. Feeder cables are assumed to run straight North, South, East or West from the wire center to a line perpendicular to the center of a side of the square representation of the CBG. From this point sub-feeder is assumed to run along the perpendicular line to the edge of the (square) CBG. Total feeder distance is calculated by subtracting ½ of the length of one side of the CBG square from the sub-feeder length first taken to the center of the square (to place the end of the feeder at the edge of the square CBG) and adding the remaining length of the subfeeder to the length of the main route feeder. Assignment of a CBG to a particular feeder route is accomplished by measuring the angle of the centroid of the CBG to the due East direction (any direction could be chosen; this one is typically chosen for measurement of radial angles) If the resultant angle is between 45° and 135°, the North route is chosen. Between 135° and 225°, the West route is chosen, etc. This process selects the route with the shortest (right angle) distance from the assigned wire center to the CBG.
- Distribution Topology. Distribution plant architecture assumes that households are evenly distributed in the reformatted (square) CBG area; that the distribution cable begins at the edge of the CBG and ends at the

[3]Note that this geometry which underlies BCM1, BCM2, and the Hatfield model creates square areas which overlap and which do not entirely cover the terrain even through the areas ____ to the area of the terrain. It is assumed that the costs of serving the overlapping areas compensate for the costs of serving the uncovered areas.

subscribers' premises; and that four legs of distribution cable are required to serve a customer within a CBG[4]. The length of these distribution legs is calculated as ¾ of the distance of one side of the CBG square. The size of the distribution cable is calculated by dividing the number of households within the CBG by 4 and selecting the next largest size cable.

- Loop Technology. Loop technology is assumed to be analog copper cable for loop lengths that are less than 12000 feet. The technology is assumed to be one of two types of fiber with digital loop carrier for lengths greater than 12000 depending upon the density of the CBG.
- Loop Components. The model does not include investments for a Network Interface Device (NID), Drop Wire, Terminals/Splices, Serving Area Interface Cabinets, Tandem Switching, Signaling Network, Transport and Operator Systems.
- Switching Technology. Switching technology was assumed to be a DMS-100 switch for all CBGs. The cost of the switch was split between common costs and per line costs.
- Density Cells. Plant technology mixes, fill factors and placement costs are assumed to vary with density in the following 6 ranges:

  $0 \leq$ and ≤ 5

  $5 <$ and ≤ 200

  $200 <$ and ≤ 650

  $650 <$ and ≤ 850

  $850 <$ and ≤ 2550

  and > 2550

[4] The claim of uniform distribution of households is false. In fact, households are assumed to be clustered at the ends of the fair distribution legs. There is not enough linear feet of distribution plant to reach uniformly distributed premises.

- Terrain. Placement costs are modified by the prevalent terrain within a CBG based on terrain and water table indicators from data produced by the U.S. Geological Survey.
- Expenses. Expenses are calculated by deriving an expense to investment ratio from ARMIS 43-01 forms excluding, in some cases, certain overhead accounts.

B. Benchmark Cost Model - Version 2 (BCM2)[5]

Version 2 of the Benchmark Cost Model is jointly sponsored by USWest and Sprint. The purpose of this model is slightly different than the purpose of the original version. While all of the goals of Version 1 are retained, an additional goal of using the model to "Serve as a basis of critique of studies of unbundled network elements" has been added.[6]

Significant changes in methodological approach have been made to BCM2 from the methods employed in BCM1. To allow for ease of comparison, the methods will be presented here in the order that the BCM1 methods were discussed above.

- Geography. Use of Census Block Group (CBG) as the geographical base unit remains in BCM2. However, to account for a bias toward longer loop lengths that occurs when significant amounts of vacant land are included in a CBG, BCM2 recalculates the area associated with a CBG if its density is 20 households per square mile or less. In CBGs that meet this criterion, a buffer zone of 500 feet on each side of the road system (or 100 square feet per linear foot of road) is constructed to substitute for the measured area of the CBG.

[5] The overview of the Benchmark Cost Model - Version 2 has been excerpted, paraphrased and derived from the methodology document provided at the sponsors July 18-23, 1996 Workshop. Where exact quotes are important to clarity they will be enclosed in quotation marks. In all other cases, liberties will be taken with sentence structure and form to enable consistent presentation.

[6] This information did not come from the document referenced in the previous footnote but rather comes from the presentation offered at the July 18-23, 1996 Workshop.

- Assignment of Wire Centers to CBGs. As in BCM 1, Assignment of CBGs to Wire Centers is accomplished by determining the nearest Wire Center on the basis of airline distance from the Wire Center to the centroid of the CBG.
- Feeder Topology. Feeder cables are assumed to be oriented as in the BCM1. From the main feeder, sub-feeder is assumed to run to the edge of the CBG (as in BCM1), unless the length of feeder would violate a maximum copper distribution limitation. Unlike BCM1, if the maximum limit of copper is exceeded, the feeder is continued into the CBG for the amount that the distance exceeds the limit. Feeder distance is calculated by subtracting ½ of the length of one side of the CBG square, or the maximum copper distribution limit, from the sub-feeder and adding the remaining airline distance to the airline distance of the main route feeder. Assignment of a CBG to a particular feeder route is accomplished in the same manner as BCM1.
- Distribution Topology. Distribution plant architecture assumes that households are evenly distributed along roadways (i.e., within the CBG area now limited to the 1000 ft. wide road swath). The distribution cable begins at the end of the feeder and ends at the subscribers' premises. Multiple legs of distribution cable are required to serve a customer within a CBG. The length of these distribution legs is based directly on the length of a side of the CBG which is modified by reference to two slope values which are input by the user. Each slope value has an associated slope modification factor that increases the length of the CBG side. The length of the distribution legs is then calculated by assuming a uniform lot size which apportions the modified CBG area to households, and calculates the number of distribution legs and length required to serve all

lots within the CBG square (or road swath). The size of the distribution cable is calculated by dividing the estimated number of lines served within the CBG (after adjustment for business lines) by the number of vertical or horizontal distribution legs in the CBG and selecting the next largest size cable.

- Loop Technology. Loop technology is assumed to be analog copper cable for loop lengths that are less than user selectable values of 9,000, 12,000, 15,000 or 18,000 feet. For length greater than the breakover length, one of two types of fiber based digital loop carrier is assumed dependent upon the density of the CBG. Additionally, loop investment is capped at $10,000 under the assumption that more costly loops will be served by an alternative wireless loop technology costing $10,000 per home served.
- Loop Components. BCM2 includes investments for a Network Interface Device (NID), Drop Wire, Terminals/Splices, Serving Area Interface Cabinets, Tandem Switching, Signaling Network, Transport and Operator Systems.
- Switching Techonology. Switching technology is assumed to be an average value for each of five switch sizes. The cost of the switch is split between start-up costs and per line costs.
- Density Cells. Plant technology mixes, fill factors and placement costs are assumed to vary with density in the following 6 ranges:

  $0 \leq$ and ≤ 5

  $5 <$ and ≤ 200

  $200 <$ and ≤ 650

  $650 <$ and ≤ 850

  $850 <$ and ≤ 2550

  and > 2550

- Terrain. Placement costs are modified by the prevalent terrain within a CBG, based on terrain and water table indicators from data produced by the U.S. Geological Survey as in BCM1.
- Expenses. In BCM2, three investment related annual cost factors are created from 1995 ARMIS data. These factors are for Cable, Switching and Circuit equipment investments. Additionally, a non-plant related expense factor is calculated by taking the ARMIS categories of Customer Operations - Marketing, Customer Operations - Services, Corporate Operations and Other Depreciation/Amortization and developing a per line expense amount, based on total access lines. The capability to scale this amount is also provided.

C. Hatfield Model - Version 2.2 (HM)[7]

The Hatfield Model was prepared by Hatfield Associates Inc. for AT&T Corporation and MCI Telecommunications Corporation. The goal of the Hatfield Model is "... to model the economic costs of all narrowband local telephone services provided to business and residence customers, including access services provided to interexchange carriers ("IXCs")." Key aspects of the Hatfield Model are:

- Geography. Use of Census Block Group (CBG) as the geographical base unit is also a feature of the Hatfield Model. The Hatfield Model obtains its geography from the BCM1, its treatment is the same as described there.
- Assignment of CBGs to Wire Centers. The assignment of CBGs to wire centers is adopted from BCM1.

[7] The overview of the Hatfield Model - Version 2.2 has been excerpted, paraphrased and derived from the document entitled *Documentation of the HATFIELD MODEL - Version 2.2 - release 1* dated May 16,

APPENDIX B

Universal Service

Assessment of the

Hatfield Model Version 2.2

and

Comparison to the

Cost Proxy Model

Pacific Bell

August 9, 1996

INDEX

I. The Hatfield Model consistently understates cash operating expenses required to provide Universal Service

A. The Hatfield Model uses embedded cost factors and incorrectly represents the results as an incremental study.

For most expenses, the Hatfield Model's basic structure is to estimate cash operating expenses by applying factors to incremental investments. Those factors are derived from relationships between embedded investments and current period expenses. This process is wrong for three reasons. First, using this factor approach is inherently flawed in an incremental cost model where the factors are applied against forward-looking equipment prices. This approach incorrectly calculates that operating expenses such as maintenance expenses will drop if an equipment vendor drops its equipment prices, or will rise if an equipment vendor raises its equipment prices. It requires no fewer technicians to repair a piece of equipment just because a vendor lowered the price of the equipment. For that reason, the Cost Proxy Model allows the user to directly input all operating expenses. While the Hatfield Model's factor approach may be useful in an *embedded* cost study where embedded investments are relatively stable over time, it has no place in an *incremental* cost study where equipment prices can be quite volatile.

The second reason why the Hatfield Model factor approach is wrong is because it assumes a factor of current operating expenses to *embedded* investments is identical to the relationship of forward-looking operating expenses to *incremental* investments. There is simply no rationale for assuming these two relationships are identical. Depending on the relationship between embedded investments and equipment prices for the newest technology, the Hatfield Model can overstate or understate operating expenses. Since in the Hatfield Model most incremental investments are assumed to be significantly lower than booked investments, the model systematically understates operating expenses.

Finally, the embedded factor approach used in the Hatfield Model will tend to overstate costs in areas that require higher investment costs but not necessarily higher operating expenses. For example, loop investments will vary by loop length and density. For low density rural areas, with higher average loop investments, the Hatfield Model will calculate correspondingly higher operating expenses. Pacific has not found that situation to be true. There are offsetting factors (no traffic control problems in rural areas) that cause similar average loop maintenance costs in rural and urban areas.

B. The Hatfield Model contains errors that incorrectly determine the cost factors it applies to investments.

(1) Digital Switch Maintenance Factor

The Hatfield Model incorrectly determines some of the cost factors it applies to investment and it applies the wrong factors causing underestimated costs. For example, in describing the Hatfield Model at the California Universal Service Workshops, AT&T and MCI identified that the model uses a digital switching maintenance factor from a New England Telephone cost study for New Hampshire.[1] The Hatfield Model inappropriately uses this factor to calculate switch maintenance everywhere, including California.

Using the New Hampshire factor nationwide is wrong. The Hatfield Model acknowledges that switching investment varies by switch size (see page 38 of Hatfield May 16, 1996,

[1] Elsewhere, the Hatfield Model uses Pacific Bell ARMIS data for development of other maintenance cost factors. This is an example of the builders of the Hatfield Model selectively choosing their processes consistently to underestimate costs.

documentation), with the largest investment per line occurring for switches with the smallest line size. Since New Hampshire is characterized by small towns with small switches, the Hatfield Model would identify these switches as having higher switching investments per line than would be the case for states like California, with most lines in large switches in metropolitan areas. However, there is no evidence that digital switch maintenance costs per line vary directly with the line size of the switch. The New Hampshire factor is low not because the maintenance expense is low but because the switch investment is high. By deriving the switch maintenance factor from New Hampshire's high switch unit investment, the Hatfield Model creates a factor only for "small town" states like New Hampshire. The factor is clearly much too low for California with its cities and lower switch unit investment. Applying the low switch maintenance factor from New Hampshire to states with lower per-line switch investment will, by necessity, underestimate the switch maintenance costs in those areas.

FCC ARMIS data bear out that the Hatfield Model's switch maintenance expense factor and reliance on New Hampshire data cause a completely unreliable estimate of switching maintenance expense. The Hatfield Model uses a digital switch maintenance factor of 0.027 from a 1992 study for New Hampshire. The 1993 ARMIS data (Figure A, below) shows that the average RBOC had a Digital Switch Maintenance factor of 0.058. The New Hampshire factor clearly has no relevance for most companies.

FIGURE A

1993 ARMIS Data -- Analysis of Digital Switch Maintenance To Digital Switch Investment

Company	Expense ($000)	Investment ($000)	Factor
All LECs	$2,206,401	$39,119,365	0.056
All RBOCs	1,615,720	27,664,686	0.058
All Other LECs	590,681	11,454,679	0.052
Illinois Bell	95,815	1,276,012	0.075
Michigan Bell	72,059	1,008,400	0.071
Bell of PA	82,146	1,193,931	0.069
New Jersey Bell	65,483	1,092,997	0.060
Bell South	346,624	5,310,713	0.065
New England Tel	73,949	1,880,782	0.039
New York Tel	182,597	3,445,909	0.053
Pacific Bell	159,274	2,933,710	0.054
Southwestern Bell	149,817	2,411,316	0.062
US West	121,877	3,270,438	0.037
GTE Calif.	96,311	1,627,242	0.059

The Hatfield Model uses a .027 digital switch maintenance factor from a 1993 study.

In the California Universal Service cost workshops, AT&T and MCI claimed to have verified the switch maintenance factor. They verified it with data reported by U S West, another company with a significant portion of its customer base in small communities. AT&T and MCI claimed that the low switch maintenance factor from New Hampshire was due to efficient operations (as opposed to higher investments). However, the factor from the 1993 ARMIS report for New York Telephone, the sister company of New England Telephone in NYNEX, had a factor of 0.053. If the factors represented relative efficiency, then both New Hampshire's and New York's factors should be equal as NYNEX would be expected to be equally efficient in each of its state operations.

Furthermore, the New Hampshire digital switch maintenance factor was adjusted in the New Hampshire study by an unexplained book-to-current cost ratio. This book-to-current cost factor reduced the actual New Hampshire cost factor. The Hatfield Model uses this adjusted factor without attempting to explain or justify that the factor is appropriate even through it produces results significantly below even New Hampshire's reported digital maintenance expenses.

The problems with the Hatfield Model switching maintenance calculations are further exacerbated by the Hatfield Model's method of estimating incremental switching investment. As discussed below, the Hatfield Model grossly understates switching investment. By applying the inappropriately low switching maintenance expense factor to a significantly understated investment, the Hatfield Model compounds its error and understates switching maintenance costs even more.

(2) Wrong Maintenance Factor Used for Buried Cable

The Hatfield Model applies the wrong cost factors to investment. For example, the latest version the Hatfield Model still incorrectly determines the cost for buried cable maintenance.[2] Although the output reports for the Hatfield Model only show aerial and underground cable, the model actually combines the buried and underground cable investments calculated within its cable module. In response to data requests from Pacific in the California universal service proceedings, AT&T and MCI acknowledged that fact (also see page 25 of the May 16 Hatfield Model documentation). Their response indicates that the model assumes 100%

[2] Pacific identified this error in the prior Hatfield version during the California Universal Service hearing in April.

buried cable in density zones less than 850 households per square mile, and 100% underground cable in the 2550+ density zone. In the remaining 850 to 2550 density zone, the model assumes a mix of buried and underground.

However, when the Hatfield Model calculates loop maintenance expense, instead of applying the buried cable maintenance factor to the buried cable investments the model applies the factor for underground cable maintenance. Since the factor for underground cable maintenance (0.031) is significantly lower than the factor for buried cable maintenance (0.068), the Hatfield Model understates buried cable maintenance by more than half.

C. The Hatfield Model consistently either understates or omits expenses associated with Universal Service.

(1) Customer Service Expenses

In the area of customer service costs, the Hatfield Model also uses data from the New Hampshire study that produced the digital switch maintenance factor. The Hatfield Model uses $1.22 per line per month for billing inquiry and bill production. However, the New Hampshire study is not a TSLRIC study. The costs in the New Hampshire study appear to be the marginal costs incurred with a 10% change in volume. This approach violates total service and FCC total element costing principles. The correct economic approach is to consider the total demand in question not just an increment. In California, AT&T and MCI agreed to costing principles for TSLRIC studies. Principle Number 3 says, "The increment being studied shall be the entire quantity of the service provided, not some small increase in demand."

In addition to understating the costs for billing inquiry and bill production by using marginal costs, the Hatfield Model also omits necessary customer service functions. One area is customer payment and collection activities. Another area is the costs associated with the maintenance and development of the computer systems and software associated with billing systems and customer service systems. Pacific's review of its costs for residence customer service activities indicates that the correct universal service value for these functions is between $2.50 and $3.00 per line per month rather than the Hatfield's value of $1.22.

(2) Service Order Processing Expenses

In an earlier version of the Hatfield Model presented in California, the model did not include costs incurred to establish and disconnect basic service. These costs are unarguably a cost of universal service. Many states including California establish below-cost installation charges to promote universal service. Likewise, the FCC has its Link-up America program. Any Universal Service subsidy calculation should include both the revenues and costs to establish and disconnect service.

In the new version 2.2, the Hatfield Model expense inputs include a factor for the service order processing portion of Account 6623, (see page 47 of the May 16 Hatfield documentation). After reviewing the Hatfield Model work papers for California, Pacific could not determine if the new version of the model actually uses the input factor to calculate service order costs for universal service. However, if the model now correctly recognizes that universal service costs should include service establishment and disconnect costs, then there are additional costs that the model does not account for in its service order processing factor.

In addition to service order costs, network administration, central office and field operations costs are incurred that are not accounted for in the factor.

(3) Overhead Costs

The overhead factor in the Hatfield Model is another example of using inconsistent and inappropriate inputs. (The model's creators have changed the name from overhead factor to variable support factor in this latest version.) TSLRIC studies do not include an overhead factor. However, all services should contribute a reasonable amount to the shared and common costs of the firm. If AT&T and MCI intend for the overhead factor in the Hatfield Model to represent a reasonable contribution to shared and common costs, then the factor is too low. At page 49 of the model documentation AT&T and MCI claim that "variable support expenses for LECs are higher than those of similar industries .... such as the interexchange industry." This is not true. Data from 1993 FCC ARMIS reports show that the embedded overhead factor for all LECs was 0.134. The factor for the RBOCs was 0.116. The factor for AT&T was 0.177. That is nearly twice the factor used by AT&T and MCI in the Hatfield Model. Also, as with every other cost factor in the model, factors based on embedded costs are inappropriately applied to incremental costs resulting in a meaningless value that is neither fish nor fowl. The California PUC has just issued a decision adopting with some modifications TSLRIC studies for the majority of Pacific Bell's services.[3] Using those studies, recovery of common costs requires about a 20% mark-up and recovery of both shared family costs and common costs require about a 40% mark-up on average over TSLRIC.

[3] Decision 96-08-21, adopted on August 2, 1996 in R93-04-003

(4) Depreciation Expenses

The Hatfield Model understates depreciation expenses by assuming unreasonably long economic lives for investments. The prior version of the Hatfield Model used a single eighteen year life assumption for all investments. No distinction was made by the model between the economic life of a building, a central office switch, a computer on an employee's desk, or the vehicles employees use. This latest version varies the life assumption by type of investment. These new lives appear to result in a weighted average of about eighteen years, perhaps even a little longer. An eighteen year service life equates to a depreciation rate of 5.55%. For comparison, the FCC and CPUC composite depreciation rates approved for Pacific are about 6.9%, nearly 25% higher than the AT&T and MCI selected rate.

However, neither the depreciation lives in the Hatfield Model nor those currently approved by the FCC and CPUC are appropriate for a TSLRIC proxy model. Those depreciation rates reflect historical plant placements and do not reflect a forward-looking long run view of the effects of full competition. Any proxy cost model intended to encourage efficient competition should reflect economic lives consistent with fully competitive markets. Those lives should reflect the competitive effects on economic lives caused by PCS, cable television, and competitive local carrier entry into the market. In the TSLRIC studies just adopted by the California PUC, Pacific used the economic lives from our recent write down of assets. Compared to the 18 year life assumption in the Hatfield Model, the weighted average economic life used by Pacific is 12.2 years. Pacific believes that a 12.2 composite economic life is consistent with the lives MFS, Time Warner, MCI Metro, and other new entrants use in their external financial reports that follow generally accepted accounting principles. For example, AT&T's 1994 reported ARMIS depreciation rate was 10.9% with an asset life of 9.2 years. Finally, in addition to understating economic lives, the Hatfield Model incorrectly omits salvage and cost of removal from the calculation of depreciation expense.

(5) Cost of Capital

The cost of capital (rate of return) can have a significant effect on the costs results because of the significant amount of investment required to provide universal service. In the Hatfield Model, an inappropriate embedded cost of capital is used instead of a forward-looking value. The model wrongly uses current capital structures (percent debt) that reflect the recent investment write-downs the RBOCs made in their external financial reports. This grossly overstates the forward-looking long-term debt percentage the RBOCs will maintain. By overstating the percent debt, the Hatfield model understates the overall weighted cost of debt and equity funding and the income taxes associated with the equity return. The Hatfield Model also appears to use an embedded cost of debt rather than a forward looking value. For the cost of equity, the model assumes 11.25% which is the right value for the overall weighted cost but wrong for the equity cost. The overall effect of these assumptions is to significantly understate the cost of capital and the associated federal income taxes in the Hatfield Model. For example, in its results for Pacific Bell, the Hatfield Model's cost of capital is 9.5% -- well below the current FCC value of 11.25%.

(6) Directory Assistance Operator Costs

In order to develop the costs of universal service, a definition of the basic core elements is necessary. One element that may be part of universal service is a monthly allowance of free directory assistance calls. In the alternative, the basic service could be defined to simply provide access to directory assistance services without any free calls. The Hatfield Model takes a curious approach to this issue. The model includes all the costs for directory assistance calling except the costs of the operator handling the call. Depending on whether directory assistance calls are included or excluded from universal service, the Hatfield Model must be modified to either include the DA operator costs or modified to exclude the network and operator position costs currently included.

II. The Hatfield Model consistently understates the long run incremental investment required to provide Universal Service.

A. The Hatfield Model understates switching investment.

In a long run incremental cost study, investments must reflect long run expected values. This the Hatfield Model fails to do. With switching equipment, or any other technology-dependent equipment, prices vary over the life of the technology, even when adjusted to eliminate the effects of inflation. By definition, a long run incremental analysis must capture the overall effect of all life cycle price variations. For switch prices to a large local exchange carrier such as Pacific, the price variations are significant and have the following pattern:

a. When a new technology, such as today's digital switch, is first introduced, the price is relatively high, as the new technology provides advantages over existing technology, and the initial vendor(s) is able to charge a premium for the advanced capability.

b. As more vendors enter the market, providing competitive equipment, prices will drop, but will still reflect the premium value associated with the advanced features of the new technology.

c. At some point, the new technology will become the standard, and the older technology will cease to be produced. During this period, switch vendors offer to provide under contract large numbers of switches, associated with replacing a large number of existing older technology switches, at significant price discounts. These discounted prices are often limited to the replacement of the older technology, and do not extend to future growth additions to the new technology. (This is the current stage of pricing for digital switches.)

d. After the replacement of the older switches has been completed, the switch replacement contracts will expire, and vendor switch prices will rise back to levels more commensurate with the relatively low volumes of purchases required to only meet growth demands (as all of the older technology switches have been replaced).

e. The last phase is late in the life of the technology, after a newer replacing technology appears, when the price of the now older technology increases rapidly as vendors exit that market.

The Hatfield Model uses understated current prices as the expected long run incremental investment.[4] The Hatfield Model fails to recognize that today's current digital switch prices,

[4] In the California Universal Service proceeding, AT&T and MCI acknowledged that the switch investment was understated by $60 per line.

even if correctly stated, are themselves significantly lower than the long run expected values of those prices for the reasons explained above (current prices are at stage c, the lowest in the life of the technology). By using its understatement of current digital switch prices, and by failing to recognize the long term pattern of price variations for digital switching equipment, the Hatfield Model grossly understates the long run switching investment. For Pacific Bell, the Hatfield Model predicts a total digital switching investment of $2,317 million. This is obviously wrong since Pacific's actual digital switching investment was already $3,370 million in 1994, even though about 35% of Pacific's lines were still being served by older analog switches. Assuming Pacific spent about $1 billion to convert those remaining analog lines to digital, Pacific's projected digital investment would be about $4.3 billion. The Hatfield Model thus starts its investment driven cost estimation process with one of its basic inputs, switching investment, at about half of Pacific's projected digital switching investment. By using only a fraction of Pacific's likely long run incremental switching investment, the Hatfield Model cannot help but grossly understate capital costs and the operational expenses it derives by applying embedded cost factors to that investment.

Furthermore, the switching investment values used in this latest version of the Hatfield Model contradict statements and testimony by witnesses representing AT&T and MCI in just concluded California Universal Service Hearings. In February, the Hatfield Model presented in California used the same switching investment information presented in this proceeding (see May 16 Hatfield Model documentation pages 37 and 38). However, in April, AT&T and Hatfield Associates presented revised digital switching investments in California admitting that the earlier values were understated and that the switching investment inputs of the model needed to be increased by $60 per line. These higher values were then used by witnesses from